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NOTES ON THE IMMATURE STAGES OF SOME TINGITIDS OF THE GENUS CORYTHUCA. PLATE 3.

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The study of these insects by the writer was begun as a consequence of noting the marked difference which was evident between the eggs of the oak-inhabiting TINGIS of this locality and the eggs figured in Comstock's Manual for the Study of Insects as those of *Corythuca arcuata*. Later it was found that the young of the Buttonwood TINGIS (*Corythuca ciliata*) so closely resemble those of the Oak TINGIS as to make their distinction possible only by microscopic examination. Say's description of *Corythuca arcuata* covers several closely allied forms which may be considered species in the process of formation. Others which are recognized as distinct species appear to be very closely allied; at least in their adult condition. The differences, which are noted in this paper, in the immature stages of the Oak, Hawthorn, and Buttonwood tingitids indicate that the relationships of these perplexing forms will be better understood when the egg and nymph stages of each have been studied.

DESCRIPTION OF THE IMMATURE STAGES OF THE OAK TINGIS, *Corythuca arcuata* Say.

Egg (Plate 3, figs. 1 and 2): subelliptical in outline, basal end rather pointed, apical end capped with a narrow cylindrical collar or band surmounted by a low pyramid with from fifteen to twenty ridges extending from the base to the apex. From the apex of this pyramid there usually arises a slender filament which is variable in length but as a rule about one fifth as long as the egg. Below the collar the egg is evenly covered with a thin layer of wax, jet black in color, and rough, resembling sand paper under low power objectives. This outer wax covering may be easily rubbed off, disclosing the smooth shiny black egg chorion. The pyramidal portion of the apical cap may be either whitish or black. The length of the egg, not including the apical filament, is about .56 mm., its greatest width about .24 mm.

For the purpose of simplifying the following description of the nymphs I will designate the three principal types of spines found in the nymph stages as follows:

trumpet-shaped spines which arise from conical, sub-conical, or elongated thick protuberances as *type no. 1*; trumpet-shaped spines which arise directly from the surface of the body or its appendages as *type no. 2*; and long simple spines which arise directly from the surface of the body or its appendages as *type no. 3*.

First instar (Pl. 3, figs. 3 and 4):— Length about .53 mm., greatest width about .24 mm. The general form is an elongated ellipse, the head end being a little more broadly rounded than the anal end. When first hatched the body is pale in color but gradually turns to dark brown and in a few hours acquires a greenish tint. The rostrum, — except the tip which is brown, — antennae, and legs are pale yellowish but soon become greenish. This greenish color of the body and appendages is apparently internal, perhaps due to the blood. The part of the head which projects in front of the prothorax when viewed from above is almost semicircular in outline. The hinder fifth of the head is rounded and covered by the pronotum. The compound eyes consisting of five reddish facets each, are situated on the extreme sides of the head just in front of the pronotum. Anterior to and a little below the eyes arise the three segmented antenna, the first two segments of which are short and stout, subequal in size, the second one bearing a very few slender spines. The terminal segment is about as long as the first two together, clavate, broadest at about three fourths of the distance toward the apex, from which point it tapers gradually toward the base and rapidly toward the tip. It is slightly curved posteriorly and is provided with long spines some of which are of type no. 3 and others of type no. 2, also with many small simple spurs and blunt sense cones near the tip. The entire length of the antenna is about two fifths the length of the body. The rostrum is four segmented and about three fifths as long as the entire body, reaching when bent backwards, to the middle of the fifth abdominal segment. The rostral setae are comparatively stout. The labrum is hyaline and about two thirds as long as the basal segment of the rostrum. Beginning at the upper side of each eye there is a light streak in the integument above, which curves forward and then backward to a point about opposite its origin in the middle line of the head where it meets its fellow and a median longitudinal streak which extends back to the base of the abdomen. It is along these streaks that the integument splits when the insect moults. On each of the two obtuse angles formed by the union of the transverse streaks on the head and the median longitudinal streak are situated two stout spines, one being directly in front of the other, — the posterior spines of type no. 2 being directed posteriorly, the anterior spines of type no. 1 being directed anteriorly. Two very minute spines of type no. 2 arise on each side of the median streak between the bases of the two posterior spines. Near the anterior end of the head there are two more pairs of spines of type no. 1, situated one spine of each pair on each side of the middle line. The subconical protuberances from which the posterior pair of these spines arise, unite at their base.

The thorax from above is about as long as the head from front to rear and is slightly wider than the head at its widest part. The prothorax is a little larger than the mesothorax and the mesothorax is a little larger than the metathorax. The pro- and mesothorax bear on each lateral margin a spine of type no. 1, which with its base is about one sixth the width of the thorax. On each side of the median streak of the prothorax there are two minute circular openings appearing as minute light spots. On each side of the median streak of the mesothorax arises a spine of type no. 1. The legs are quite stout and when straightened are nearly as long as the body. The coxae are stout, nearly as long as broad. The

trochanters appear to be present though difficult to distinguish. The tibiae are a little longer than the femora and more slender, at the tip bearing several short stout spines. The tarsus consist of two segments, the basal segment being small, not very distinct, and triangular in outline viewed from the side; while the last tarsal segment is rounded above, flat below and bears two stout claws at its tip. The two tarsal segments of each leg together are a little more than one half as long as the tibia. A few slender spines occur on the various segments of the legs.

The abdomen consists of ten segments, only nine of which are ordinarily visible from above. The ninth is quite long and bends downward so that the short anal segment is nearly perpendicular to the surface upon which the insect rests. This segment — the tenth — appears kidney shaped when viewed from the side, with the concave surface where the anal opening is situated directed downward. The second to the ninth segments inclusive, bear on their lateral margins, spines of type no. 1 which correspond to those described on the sides of the pro- and mesothorax. The dorsum of the second abdominal segment bears two spines which correspond to those on the dorsum of the mesothorax. The fifth and sixth segments are much swollen in the middle of the dorsum and each of them bears three spines on each side, the posterior one being of type no. 1 and smaller than the other two which are of type no. 2. On each side of the mid-dorsal line of the eighth segment there arises a spine of type no. 2. Directly behind each of these near the posterior margin of the eighth segment arises a spine of type no. 1. Minute pores and spines also occur on the dorsum, the latter being confined mostly to the middle of the sixth segment. A little mesad from each lateral margin, on the ventral surface of the second to eighth segments inclusive, are projections not unlike truncated cones, at the outer, smaller end of which are the tracheal openings. A little mesad to the openings on each side of the body on the venter of each of the fifth, sixth, and seventh segments is a slender spine of type no. 3. On each side of the second to eighth segments about opposite the spiracles viewed from above are small areas bounded by chitinous rings. These structures disappear at the first moult and their significance is not known. They appear to be located just below the surface of the body, hence are not represented in the figure.

Second instar (Pl. 3, fig. 5): Length varying from 1.2 to 1.32 mm.; the greatest width from .68 mm. to .72 mm. The change which occurs at the first moult is not great. The body becomes somewhat broader in proportion to its length. The rostrum reaches to about the caudal margin of the second abdominal segment. The legs are shorter in proportion to the length of the body than before, being a little less than two thirds as long as it. The entire dorsum of the body except for certain definite areas is covered with minute dark colored spines. On the venter these spines occur only near the lateral margin. The dorsal spines of the first instar have been changed in two ways: first, new ones have been added, and secondly, spines of type no. 1 which in the first instar arose from small protuberances (Pl. 3, fig. 4) now arise from protuberances which average about the same length as the spines themselves, which are in most cases actually shorter than before. The principal additions of spines in the head region are: a minute one of type no. 1 added to the pair of the same type which occur just behind the most anterior pair; two small spines of type no. 1 and one small spine of type no. 2 added to each of the next two groups which occur one on each side of the middle line between the eyes. Elsewhere on the dorsum are the following additions: four minute spines of type no. 1 now occur on the prothoracic segment, two on each side of the middle line, one being near the anterior margin and the other near the posterior margin of the segment; on the mesothorax two spines of type no. 2 have been

added on each side of the middle just caudad to the spines of type no. 1 which were present in the first instar; just mesad from the base of each protuberance which gives rise to the marginal spines of type no. 1 on the pro- and mesothorax and on the second to ninth abdominal segments arises a spine which may be either of type no. 2 or of type no. 3; and minute side protuberances giving rise to spines of type no. 1 begin to appear as buds from the protuberances on the margin of the pro- and mesothorax. Here and there among the minute dark spines on the surface of the body are minute circular openings from which, when viewed obliquely, little sac-like bodies are seen to protrude.

Third instar (Pl. 3, fig. 6): Length varying from 1 mm. to 1.06 mm., the greatest width from .52 to .56 mm. This instar does not differ greatly in structure from the previous one. The portion of the antenna which represents the apical segment of the previous instar is now indistinctly divided into two segments, the outer one being slightly shorter than the inner one. The rostrum reaches to about the posterior margin of the first abdominal segment. The pro- and mesothorax are proportionally broader than before and the former is proportionally longer from front to rear. The protuberances which give rise to spines of type no. 1 are now, as a rule, about twice as long as the spines. Nearly all of the spines of type no. 2 of the previous instar are now present in the form of type no. 3. A few spines of type no. 2 appear for the first time on the outer sides of the tibiae. The number of facets of the eyes has increased to eleven or twelve. A few small spines of type no. 1 appear for the first time on the lateral margins of the pro- and mesothorax anterior to those present in the previous instar, and also one or two similar ones arise from the sides of the protuberances which give rise to the spines on each lateral margin of the pro- and mesothorax and of the fourth to seventh or eighth abdominal segments. As a rule there is one which arises from the under side of each of these protuberances. Between the facets on the posterior side of each eye arises a spine of type no. 3.

Fourth instar (Pl. 3, figs. 7 and 8): Length varying from 1.3 mm. to 1.44 mm., greatest width from .74 mm. to .86 mm. The most noticeable change which takes place at the third moult is the first appearance of the wing pads, which arise as curved, backward growths of the sides of the mesothorax, giving this segment of the body a form suggestive of the outline of a dumbbell. The wing pads extend back on each side to a little beyond the anterior margin of the first abdominal segment. The prothorax is proportionally longer than before, and the facets of the eyes are more than twice as numerous as before. The terminal segment of the antenna has not increased in length in proportion to the other segments and is now about two thirds as long as the third or preceding segment. The constriction between the two terminal segments is more marked than before. The rostrum reaches to about the base of the abdomen. Spines of type no. 1 now arise from bases which average about four times as long as the spines. A few more spines of this type have made their appearance arising from the bases of those previously present on the lateral margins of the pro- and mesothorax and of the fourth to seventh segments of the abdomen, and a single one of the same type has arisen independently on the lateral margins of the pro- and mesothorax in front of those which appeared independently in previous instars.

Fifth instar (Pl. 3, fig. 9): Length varying from 1.86 mm. to 2 mm., greatest width from 1.1 mm. to 1.36 mm. Quite a marked change in form occurs at the fourth moult, the most noticeable of which is the increased length of the prothorax in proportion to the length of the body and the increase in length of the wing pads. The prothorax now occupies a little more than one fourth the entire length of the body. The wing pads now extend back on each side a little beyond the posterior margin of the fourth abdominal segment. On the outer

side of each wing pad about four fifths of the distance from the tip to the base is a prominent shoulder. The rostrum reaches to about the middle of the mesothorax. The fourth segment of the antenna is now about one half as long as the third. Spines of types nos. 2 and 3 are more numerous than before on the antennae and legs. On the head four more spines of type no. 1 appear in connection with the group present in the previous instar:—one on each side of the second (next to the anterior) group, and one on each of the two posterior groups. A few small spines of type no. 1 appear for the first time on the sides of the pro- and mesothorax and of the fourth to ninth abdominal segments. The second and third abdominal segments have lost the spines of type no. 1 which in previous instars were present on their lateral margins. The area covered by the minute dark spines is much more limited than before. The integument is shaded with brown as before except where there are large spaces devoid of these small spines; the color here is dull yellow, thus giving a somewhat broken light band across the body in the region of the tips of the wing pads. The facets of the eyes are much more numerous than in the previous instar.

The eggs of the OAK TINGIS are found on the under surfaces of the leaves, usually near the larger ribs and in groups ranging from two or three to more than one hundred in numbers. Single isolated eggs are occasionally found. Judging from the number of eggs as compared with the number of adults early in the summer, many eggs must be laid by each female. During the last few days in May of the present year (1903) it was observed that, on those oak leaves where any of the insects occurred, a male and a female were usually found together; rarely one and still more rarely three and four individuals, were found on a single leaf. On many of the leaves where there was but one pair of the insects the numbers of eggs ranged from twenty-five to fifty.

The nymphs remain together in clusters. Their wanderings on the under surface of a leaf are marked by their shiny, black, rounded excrements which are apparently deposited on the leaf by means of the peculiar tenth abdominal segment already described. The moulted skins of the nymphs remain attached to the leaf by their tarsal claws as already observed by Comstock in the Hawthorn TINGIS.

The upper surfaces, particularly along the sides of the mid ribs, of leaves of badly infested trees, turn dirty pale green, sometimes mottled with reddish, and the ornamental effect of whole trees may be greatly impaired by midsummer unless spraying is resorted to.

From two to three days intervene between each succeeding moult up to the fourth, and from six to seven days between the fourth and fifth moults. The duration of the egg stage is unknown to the writer, but eggs laid on the leaves of certain oaks on the college grounds about the middle of May were unhatched on June first, the time of the present writing.

The adults hibernate beneath the bark, under leaves, and among rubbish.

The writer has found adults of *C. ciliata* hibernating in large numbers in crevices in an old wooden fence which ran below the branches of a buttonwood tree.

A few very small pinkish immature heteropterous insects were once found to be very active in destroying the young nymphs of the Oak TINGIS but none were bred to maturity. The adult form of a well-known predaceous heteropteron — *Triphleps insidiosus* Say — has been found feeding on the young of *C. ciliata* and from the similarity in the general appearance and habits of this adult and the immature forms just mentioned it seems probable that they were of the same species.

A group of oaks on the college grounds gave an excellent opportunity for observations on the food plants of the Oak TINGIS. The following oaks were found to be badly infested: white oak (*Quercus alba*), chestnut oak (*Q. prinus*), English oak (*Q. rubra*), and dwarf chestnut oak (*Q. acuminata*). The following were apparently entirely immune to the attack of the insect although they stood so near to badly infested trees that their branches touched in some cases: scarlet oak (*Q. coccinea*), scrub oak (*Q. illicifolia*), and laurel oak (*Q. laurifolia*). A specimen of mossy cup oak (*Q. macrocarpa*) growing a few hundred yards away was slightly infested.

THE HAWTHORN TINGIS, *Corythuca arcuata crataegi*, subsp. nov.

During the summer of 1902 there was received at the Hatch Experiment Station of the college a branch of hawthorn from Concord, Mass., which was submitted to the writer for examination. The leaves were discolored and practically dead, which condition appeared to be due to a combination of both insect and fungus pests. Among the remains of various insects, a few moulted skins of tingitids were found which corresponded very well with the respective instances of the Oak TINGIS. A few eggs were also found upon the hawthorn leaves which agreed with the figure and description given by Comstock in his report for 1879 (Rept. Comm. Agric., 1879, 1880, p. 221). The eggs are there described as follows: "The eggs of these insects . . . are smooth, whitish, glistening, semi-transparent, and ovoid in shape. Their average length is .3 mm. (.01 inch). They are deposited on their broad end, and seem to be somewhat inserted into the substance of the leaf; they are covered completely by a brown, sticky substance which hardens soon after oviposition. It adheres so firmly to the egg, especially to the upper portion, that it is impossible to remove it without crushing the egg. At its upper end this covering of the egg is squarely truncate, giving the whole mass the appearance of the frustum of a cone with a porous lid. . . . They

bear a much greater resemblance to certain forms of fungi, notably the genus *Phoma*, and to certain homopterous galls than they do to eggs of any sort." Uhler, to whom were referred the specimens of the Hawthorn TINGIS in his note determining the species said: "Your specimens of TINGIS belong to the genus *Corythuca*, and seem to be a new phytophagic form of *Corythuca arcuata* Say. It will hardly do to make a new species out of this insect, as it is one of the several forms which fit into Say's species. It comes near to the race belonging to the *Juglans nigra*."

Better material than that which I have thus far examined would probably show some differences in the nymphs of the oak- and hawthorn-inhabiting TINGIS but from a comparison of the eggs alone it is evident that the two forms should not be considered identical or even local varieties. I suggest therefore that the subspecific name *Corythuca arcuata crataegi* be used in association with the common name Hawthorn TINGIS, while Oak TINGIS be exclusively used for the common name of *Corythuca arcuata*. Say in his description not having mentioned the food plant, it will be necessary thus to designate a variety as the type of the species, and the oak infesting variety seems to be the most commonly accepted type.

THE BUTTONWOOD TINGIS, *Corythuca ciliata* Say.

While to the naked eye or with a hand lens the young stages of *C. arcuata* and *C. ciliata* are almost inseparable, with a compound microscope, using an objective not lower than one half inch, the two species can be readily distinguished. The most striking characters of each instar of *C. ciliata* by which it can be distinguished from *C. arcuata* are here given:—

First instar: The spines corresponding to types no. 1 and no. 2 are not trumpet shaped but are rounded and much larger at the tip than in *C. arcuata*. Spines corresponding to type no. 2 are especially prominent on the antennae.

Second instar: Most of the spines which correspond in position to type no. 1 in *C. arcuata* are now pointed at the tips; a few have not completely changed from their form in the first instar. The antennae bear prominent spines as before.

Third, fourth, and fifth instars: These stages are best distinguished from the corresponding stages of *C. arcuata* by the presence of spines corresponding to type no. 1 but with the form described in the first instar. The spines on the antennae are less prominent than in the first two instars.

This species was found to be extremely abundant at Amherst, Mass., in September, 1902, on the leaves of a buttonwood or sycamore tree (*Platanus occidentalis*) growing near the college grounds. Many adults were found under the bark as late as the first of June, 1903, but none were found on the leaves. Unfortunately no eggs were collected in the autumn with the other stages, and in the spring none were found in time to allow notes to be made on them for this paper.

EXPLANATION OF PLATE 3.

The Oak TINGIS, *Corythuca arcuata* Say.

- Fig. 1. Side view of egg.
- Fig. 2. Top view of egg.
- Fig. 3. Dorsum of first instar.
- Fig. 4. Spine from lateral margin of first instar.
- Fig. 5. Dorsum of second instar.
- Fig. 6. Dorsum of third instar.
- Fig. 7. Dorsum of fourth instar.
- Fig. 8. Spine from lateral margin of fourth instar.
- Fig. 9. Dorsum of fifth instar.

SOME HITHERTO UNKNOWN NYMPHS OF ODONATA FROM
NEW MEXICO.

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During the year 1902, dragon-fly nymphs were collected in three New Mexico localities, each of which yielded material of interest.

(A.) *Las Vegas Hot Springs*, 6709 ft. alt.

A few years ago some specimens of *Hyponcura lugens* were collected at Las Vegas Hot Springs, and upon investigation it appeared that the species occurred there as a permanently established and tolerably numerous colony. This excited some surprise, as the place is hundreds of miles from the nearest previously-known locality for *Hyponcura*, and is in the Transition zone, where the insect was hardly expected to occur. That the colony was really an isolated one appeared probable not merely from the absence of other New Mexico records, but from the fact that we could not find the species in other localities, such as the Arroyo Pecos, which were very prolific in agrionines. The search for nymphs of *Hyponcura* was at first

¹ The descriptions of the nymphs are by Dr. Needham. The material was collected by Mr. and Mrs. Cockerell, and Mr. Cockerell is responsible for the matter relating to localities, etc.